A+ Unit One: Safety and Electrical

Student Name		Member of Team		Team Lead		AM/PM
A+ Test	Essentials 701					

A+ Certification Objectives Covered

1.8 Install an appropriate power supply based on a given scenario.

- ☒ Connector types and their voltages
  - SATA
  - Molex
  - 4/8-pin 12v
  - PCIe 6/8-pin
  - 20-pin
  - 24-pin
  - Floppy
- ☒ Specifications
  - Wattage
  - Size
  - Number of connectors
  - ATX
  - Micro-ATX
- ☒ Dual voltage options

5.1 Given a scenario, use appropriate safety procedures.

- ☒ ESD straps
- ☒ ESD mats
- ☒ Self-grounding
- ☒ Equipment grounding
- ☒ Personal safety
  - Disconnect power before repairing PC
  - Remove jewelry
  - Lifting techniques
  - Weight limitations
  - Electrical fire safety
  - CRT safety – proper disposal
  - Cable management
- ☒ Compliance with local government regulations

5.2 Explain environmental impacts and the purpose of environmental controls.

- ☒ MSDS documentation for handling and disposal
- ☒ Temperature, humidity level awareness and proper ventilation
- ☒ Power surges, brownouts, blackouts
  - Battery backup
  - Surge suppressor

Turn in for this unit		Time Allotted	8 Days
Labs	Lab Report	Team Lead Check Off	Teacher Check Off
1-1			
1-2			
1-3			

1-4			
1-5			
1-6			
1-7			
1-8			
1-9			
1-10			
1-11 Diodes			

Unit Project (one per group)	
✓ Customer Overview	
✓ List of current needs	
✓ List of future needs	
✓ List of questions asked of customer	
✓ Written (at least 2 full page, double spaced) proposal that describes, in clear English, your solution.	
✓ Diagram of computer components	
✓ Worksheet from lab	
✓ Printout of spreadsheet showing complete cost of ALL computers and hardware and software	

Safety and Power

Sno Isle Skills Center

Personal Safety and Power

- **Your primary responsibility as a technician is to ensure _____ safety for yourself and others**
- **Before working on a computer**
  - **Clear _____**
  - **Get _____-static mat/bag**
  - **Remove power _____from wall/device**
  - **Remove _____battery**
  - **Ensure you are _____***

Personal Safety

- **Power**
  - **The power from the wall is _____current**
  - **It cycles at _____mhz with _____volts**
  - **That is enough to _____you**
  - **Even when the _____is unplugged, it retains power in capacitors**
    - ***Their job is to absorb and store power, and deliver current***
    - ***Can retain enough _____and _____to kill you, even hours after the device is unplugged****

Power Supply Safety

- **A power supply is an FRU, or _____ _____Unit**
- **It is NOT an SU, _____Unit.**
- **Why?**
  - **Because the _____contain enough voltage and current to kill a**

person*

Other High Voltage Components

- CRT (_____Ray _____Monitor)
- Laser _____
- Anything with large _____, which are necessary to deliver a consistent flow of _____to the device.
  - Small capacitors, such as on a motherboard, are _____*

Grounding

- Use a grounding-_____
  - _____
  - _____strap
- _____
- Attach _____from strap to an _____surface on the computer
- NEVER ground yourself to a high _____device
  - _____are the path of least resistance
  - In the event of a surge, the current will go through your _____.
  - This could kill you.*

Proper Grounding

Hot Stuff

- The CPU and RAM get really _____, so allow them to cool so that you don't get burned.
- CPUs get hot enough to _____water.
- _____may as well.*

Other Safety Considerations

- Clean area so you nor others can _____over components

- Watch _____. It should not run across the _____.
- Lift _____devices carefully, with your knees, not your back.

Fire Safety

- Any time you work with _____or heat, there is the potential for _____.
- All work areas should have a Class C fire extinguisher in an easily accessible location.*

To Use a Fire Extinguisher

- P_____—the pin or plastic
- A_____—At the BASE of the fire
- S_____—the trigger
- S_____—from side to side until fire is out

- Do not just leave, watch it does not _____.
- Only fight SMALL fires with an _____. Large fires…get the _____outta there!

Extinguisher Classes

- A—_____only, good for wood, paper fires with no chemicals.
- B—_____extinguishers for flammable _____and _____sources (plugged in).
- C—Dry _____coat the fire with a dry chemical to smother it. _____the oxygen from the fuel and stops the chemical reaction from the fire.
- Use a Class _____ or _____.

MSDS

- Material Safety Data Sheet
  - How to handle _____
  - How to _____

- How to deal with _____
- _____at which the chemical will combust
- And MUCH more

- MSDS for every single _____ (except water) that is used in your job.41

MSDS Must be kept ON SITE

Lasers

- _____can cause blindness, so take care
  - Laser _____
  - Laser _____
  - Laser _____
  - _____drives (although how your eye would get in there is beyond _____)
  - _____optic cable
- Use proper equipment for testing. Do not "_____" test anything with lasers.

Introduction to Basic Electricity

- Electricity starts with the _____.
  - Every atom contains one or more _____
  - Every electron has a negative charge
  - Electrons _____around the nucleus of the atom
  - The _____has a _____charge
- Most items (wood, plastic, etc.) have electrons _____bound to them. They don't give off a charge. These would be electrical insulators.
- Some items have free _____that can detach and _____around. These are called electrical _____.
- In order for electrons to move, the must have some form of conductor.*

The Lowly Atom

Introduction, cont

- **The flow of electrons is from a negatively charged location (terminal) to a positively charged location (terminal).**
- **Energy causes electrons to move from one atom to another.**
- **This is known as electron current flow.***

Circuit

- **What makes electrons move through a circuit?**
- **_____are attracted to a _____charge and repelled by a negative charge.**
- **If there is a difference between the _____and negative points, this is called _____or _____force.**
- **Electrons always move in the direction of the _____, away from the _____.**
- **This force is measured in _____.***

What does my PSU do?

- **Convert _____to DC**
- **Converts _____to meet the needs of the variety of components in the system.**
- **Cleans up the _____ (to some extent).**
- **Problems with the PSU can show up in a variety of ways.**
- **Most work either in the US or Europe**
  - **_____US**
  - **_____Europe**

Power Supply Troubleshooting Guidelines

- **A failing power supply may display a variety of symptoms.**

- **Power supplies typically convert about _____watts, enough for all of the typical components found in a computer.**
- **You can calculate the total wattage required for all your computer devices and compare the total to the rated _____of the power supply.***

Remember!!

- **A power supply should typically run at about _____% of its rated capacity or less.**
- **Since the power supply contains the _____that cools the _____with the flow-through of air, be sure to keep the vents on the power supply clear. Otherwise, the computer can _____.**
- **Since a _____power supply can destroy a system board, never replace a system board without first _____that the power supply is functioning properly.***

Upgrading the Power Supply

- **If the power supply can no longer supply enough power or watts for the system to operate normally, it should be _____.**

Review

- **What are some symptoms of power supply problems?**
- **How many watts does a typical power supply convert?**
- **What can be a worst case scenario with a bad PSU?**
- **How do you figure what wattage rating your power supply should have?**
- **Power supplies should run at _____ of capacity for safety.**

Surge Protection and Battery Backup

- **The following are three categories of backup power and conditioning devices:**
  - **surge _____**
  - **_____conditioners**
  - **_____power supplies (UPSs).**

- **These devices install between the _____current and the computer to filter the AC input and provide backup power when the AC v fails.***

Surge Suppressor

- A surge _____**or** surge protector **provides power outlets that are protected from an over-voltage of AC power.**
- **Not always _____because a fuse that is used to protect the devices plugged into it may be blown, but everything apparently continued to function properly.**
- **For this reason, it is best to replace surge protectors every _____months.***

Buying a Surge Protector

- **When purchasing a surge suppressor, it will have a _____rating that indicates the maximum voltage allowed through a surge protector to the devices.**
- **The _____the let-through measurement, the better the surge protection.**
- **The degree of protection of a surge suppressor is measured in _____.***

Line Conditioner

- **In the event of "dirty power" a line _____can clean up the signal.**
- **Often used in _____equipment to produce static-free sound.**
- **Can also be used in the home/business.***

Uninterruptible Power Supply

- **The best kind of power protection is an _____**power supply (UPS)**.**
- **It provides excellent _____protection as well as backup power in the event that the AC current fails.**
- **A UPS is rated by the amount of _____it provides and the length of time it can provide power during a blackout.**

The Intelligent UPS

- **Connects to the _____or _____port and can:**
    - **Send a warning to users logged into a server about _____shutdown.**

- **Run a _____or batch file when power is lost.**
- **Send a second message to users if power is _____.**
- **Shut down a _____/computer correctly before batteries die.***

When Buying a UPS

- **Consider:**
  - **Whether it conditions the line for both _____and spikes.**
  - **Whether it provides power during a _____.**
  - **Whether it protects against very high _____**
  - **Whether the VA rating for the UPS is at least 25 percent higher than your total _____output**
  - **Whether the _____and service policies are satisfactory**
  - **Whether the length of time the _____backup will last fits your needs***

Review

- **What are three things you can purchase to protect your computer from spikes, browns, and other electrical problems?**
- **What does a surge protector do?**
- **What is the purpose of a line conditioner?**
- **How does a UPS work?**
- **What are two types of UPSs?**
- **What can a smart UPS do?**

ESD and EMI

- ESD (_____discharge)—a **brief flow of electricity caused by two objects with different voltage potentials coming into contact with each other.**
- **ESD can cause _____damage to computer components.**
- **Before you work on a computer, it is very important that you are _____.***

Just a Little Shock, Right?

- **The human body carries an electrical charge of 200-300 volts.**
- **A "shock" can send 10,000+ volts of power into a _____.**
- **This is enough to _____electrical equipment.**
- **The more painful the shock, the more volts.***

Exceptions

- **When working on** power **_____or _____.**
- **Capacitors in these devices _____a high charge even when they are turned off.***

EMI

- **_____**interference **is a magnetic field produced as a side effect from the flow of electricity.**
- **EMI can cause corrupted data in _____lines that are not properly shielded.**
- **_____is temporary and does not cause _____damage to computer equipment.***

Shorts and Grounding

- **Short–when _____flows un-controlled from hot line to neutral line or from hot line to ground.**
- **The _____line helps contain the energy to avoid fire.**
- **A fuse in a _____prevents too much current from flowing through. ***

Wiring

- **In most home wiring, a _____or _____wire is used for ground, white for neutral, and black for hot.**
- **In most PC wiring, however, _____is used for ground, red for hot, and green for neutral.***

Review

- What is a short?
- What is the purpose of a fuse in a circuit?
- What does a ground line do?
- How is wiring in a computer and wiring in a house different?
- What is ESD?
- Why do you need to protect from ESD.

Review again

- The human body carries _____of voltage.
- How many volts can a “shock” of static electricity cause?
- What is EMI?
- Is EMI dangerous?
- How can you protect data from EMI?
- When should you use a grounding strap?
- When not?

Measuring Electricity

- Use a _____for most electrical measurements

Measuring Electricity

- _____—measure the electrical difference using a voltmeter.
    - Attach the leads to either side of a component and measure the difference between the two.
    - The difference or drop in voltage is measured across the wire
- Amps—measure the volume of electricity flow using an ammeter
    - place in the path of the flow with power on.*

Measuring Electricity, cont.

- _____—measure the resistance of a cable using an ohmmeter.

- The device should not be plugged in.
- The _____or multimeter sends a small charge through the wire and measures the resistance in the wire*

Voltage

- _____is the measure of the electrical force that drives electrons through a system.
- The difference in "electrical pressure" between two points is called the voltage and is measured in _____.*

Amperes (Amps)

- An _____system maintains the same amount of "current" throughout the whole system.
- The measurement of this electrical "current" is called _____or amps for short.*

The Relationship Between Voltage and Current

- To increase the amount of _____flow through the water system you simply increase the water pressure.
- The same holds true for electricity: to increase the amount of electrical "current" (amps), you simply increase the amount of electrical "pressure" (Volts).*

OHMS

- _____is the force that opposes the flow of electricity.
- An _____is the electrical measurement for resistance.
- A _____controls electricity by resisting its natural flow.
- Objects with low resistance are conductors (copper, for example)
- Objects with his resistance are _____ (plastic, glass)*

Relationships Among Voltage, Current, and Resistance

- **An _____system has a direct relationship between pressure differential (voltage) and current.**
- **Resistance (measured in _____) has an inverse relationship between voltage and current**
- **As resistance increases, either current or _____decreases.**
- **As resistance decreases, current increases. This is known as _____**law **and states that there is an inverse relationship between resistance and current.***

Wattage

- **_____measures the total amount of power needed to operate an electrical device.**
- **To determine wattage, use the following formula: _____**x **_____= Wattage (watts)***

Ground

- **What is a ground?**
- **Ground _____means there is no difference in voltage between a circuit point and the earth.**
- **In other words, there is not pathway for electricity to flow. _____stop.**
- **A grounding strap allows us to not attract the _____if there is a short in the system.**

Review

- **_____ are a measurement of resistance.**
- **_____ is a measurement of differential.**
- **_____ is a measurement of the flow of current.**
- **What is wattage?**
- **What is the purpose of a ground?**
- **If you increase _____ you reduce amps.**

- **If you increase _____ you increase amps.**
- **If you decrease _____ you increase amps.**

Review

- **Define voltage**
- **Define amperes**
- **How do you measure voltage?**
- **Define ohms**
- **What is current?**
- **Watt (he he) is electricity?**
- **AC is?**
- **DC is?**

Review 2

- **What converts AC to DC and vice versa?**
- **Wall plugs give you __ current.**
- **How can you determine wattage?**
- **What is Ohms Law?**
- **What is a resistor? What are they used for?**
- **A power supply converts house current from _____volts _____ or _____volts.**

PCs Electrical Components May Be Made From

- **_____such as gold or copper wire that easily conduct electricity.**
- **_____such as glass or ceramic that resist the flow of electricity.**
- **_____such as silicon that conduct electricity.**
- Transistors **made of layers of _____material that serve as a gate or switch for an electrical signal and can amplify the flow of electricity. ***

PC Electrical Components May Be Made From:

- **_____that hold an electrical charge for a period of time are used to smooth out the uneven flow of electricity through a circuit such as those in monitors or power supplies.**
- **_____that allow electricity to flow in only one direction and may act as a rectifier.***

Environmental Concerns

- **You must _____of things properly**
  - **Cannot go in garbage**
    - **_____**
    - ***Motherboards***
    - **_____**
    - **_____*supplies***
    - ***Printer and toner* _____**
    - ***Cleaning* _____**
- **You are responsible for ensuring you know what to do with these to comply with local/ state laws.**

Lab 1-1 Basics of Electricity

Go to the following webpage and go through the interactive electricity lab for an overview of the basics of electricity.

http://ippex.pppl.gov/interactive/electricity/

- Before beginning, get a balloon from me.
- As you do the lab, answer the questions below.

1. What is an atom?	
1. What is the normal "charge" of an atom?	
1. Define electricity.	
Before doing the balloon thing, get AWAY from the computers. Static electricity can kill the computer. When you rub a balloon on your head you literally create tens of thousands of volts! This voltage has no current and is literally waiting to be conducted to another source. Touching a good conductor, such as metal, moves the voltage from your body through to the grounded object you just touched. Scuff your shoes on the carpet and that's 10,000+ volts being built up. The more painful the shock, the higher the voltage! **That's why some physicists call static electricity high voltage electricity!**	
1. Why will a balloon rubbed against your hair or a wool sweater stick to a wall?	
1. Charge up your balloon and try to stick it to your neighbor's balloon. Does it stick? Why or why not?	
1. Since rubbing your hair against the balloon, or your feet on the carpet, creates a positive charge, why is it important to ground yourself before working on a computer?	
1. What happens during a storm that causes lightning?	

1. Describe how electricity flows through a wire.	
1. Define resistance	
1. A copper wire would have what kind of resistance?	
1. Why are plastic and glass good insulators?	
1. How do you get an atom or group of atoms to create electricity?	
1. Define volts	
1. What is the purpose of a switch in an electrical circuit?	
1. How can you measure the current passing through a wire?	
1. What is this measurement called?	
1. As resistance gets _____ amps get higher.	
1. As voltage gets higher, amps get _____.	
1. In magnetism, opposite poles _____ and similar poles _____.	
1. Describe a magnetic field.	
1. What is a simple way to make a magnet?	
1. Circling a magnet around a wire will produce what?	
Extrapolate from what you learned.	

1. Why is it important to keep small magnets away from computers?	
1. How come static electricity can fry a computer component?	
1. Why are there different wattage ratings for different power supplies?	

Lab 1-2 Basic Electrical Circuits

Requirement	Check
Created circuit	
Added switch	
Drawing of circuit	
Measured voltage	
Measured amps	
Answered questions	
Cleaned up station	

Objective

The objective of this lab exercise is to demonstrate and define basic concepts and terminology related to the study and use of electricity. After completing this lab exercise, you will be able to:

- Create a simple switched circuit.
- Describe the relationship among voltage, amperage, ohms, and wattage.
- Use a multimeter to measure voltage and amperage.

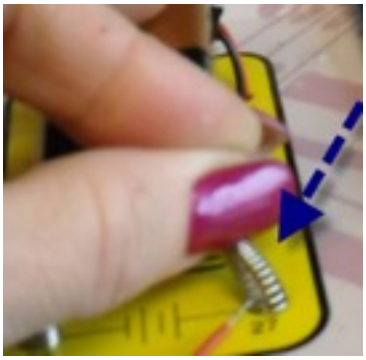
Materials Required

- One 9-volt battery
- Electronic Playground and Learning Center
- Four pieces (two short, two long) of standard-grade electrical wire

ACTIVITY

Creating a circuit

1. Connect your 9volt Battery to the board.
2. Take your long wires.
3. Attach one end of one to LED2s first lead (3). To attach, bend the spring, slip the exposed end of the wire in between the springs.
4. Now attach the other end to 27.
5. Take the end of that wire and attach it to the first spring on the battery (26)
6. Now attach another wire between 4 and 26.
7. What happens?



8. Why?

Creating a Circuit with a Switch

1. Disconnect your wires from the battery.
2. Connect one long wire from 3 to the 10kΩ connector. Notice that you see a little resistor there. A resistor **resists** or slows the flow of energy. Remember that.
3. Now connect one long wire from 4 to 26.
4. Take your two small wires. Connect one from 27 to 56. Push the button. What happens?

5. Why?

6. Where do you need to connect the other small wire to create a circuit controlled by the switch?

7. Not move your wires from the 10kΩ to the 1kΩ and push the switch.

8. Turn on the light and what happens? Is the light brighter, or dimmer?

9. Why?

10. Which of those resistors slows the flow of energy down more?

11. What do you think will happen if you attach the leads to the 100kΩ resistor?

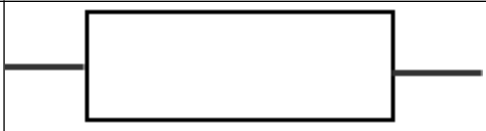
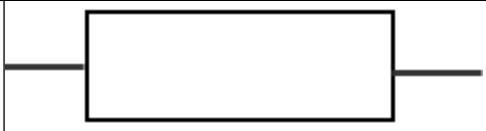
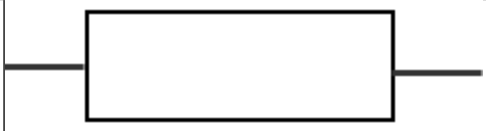
12. This is **Ohms Law** in action! Ohms law states that

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

Current= voltage divided by resistance…or the higher the resistance, the lower the current flows. If you have lower resistance, the faster the current can flow. Voltage is what makes the current flow. Lower resistance=brighter LED.

13. Look at each of your resistors very closely. What do you notice about them?

14. Draw the following resistors and label the colors of their bands

Resistor	**Drawing**
1kΩ	
10kΩ	
100kΩ	

The color bands tell you what the resistor is.

- The first ring is the first digit of the resistor's value
- Second ring is the second digit of the resistor's value
- Third ring tells you the power of ten to multiply by (or the number of zeroes to add)
- Fourth ring tells you the construction tolerance. Most have a gold band for 5% tolerance, which means that it is guaranteed to offer resistance within 5% of the marked value. (So a 100kΩ transistor with a gold band would offer resistance from 95 to 105Ω).

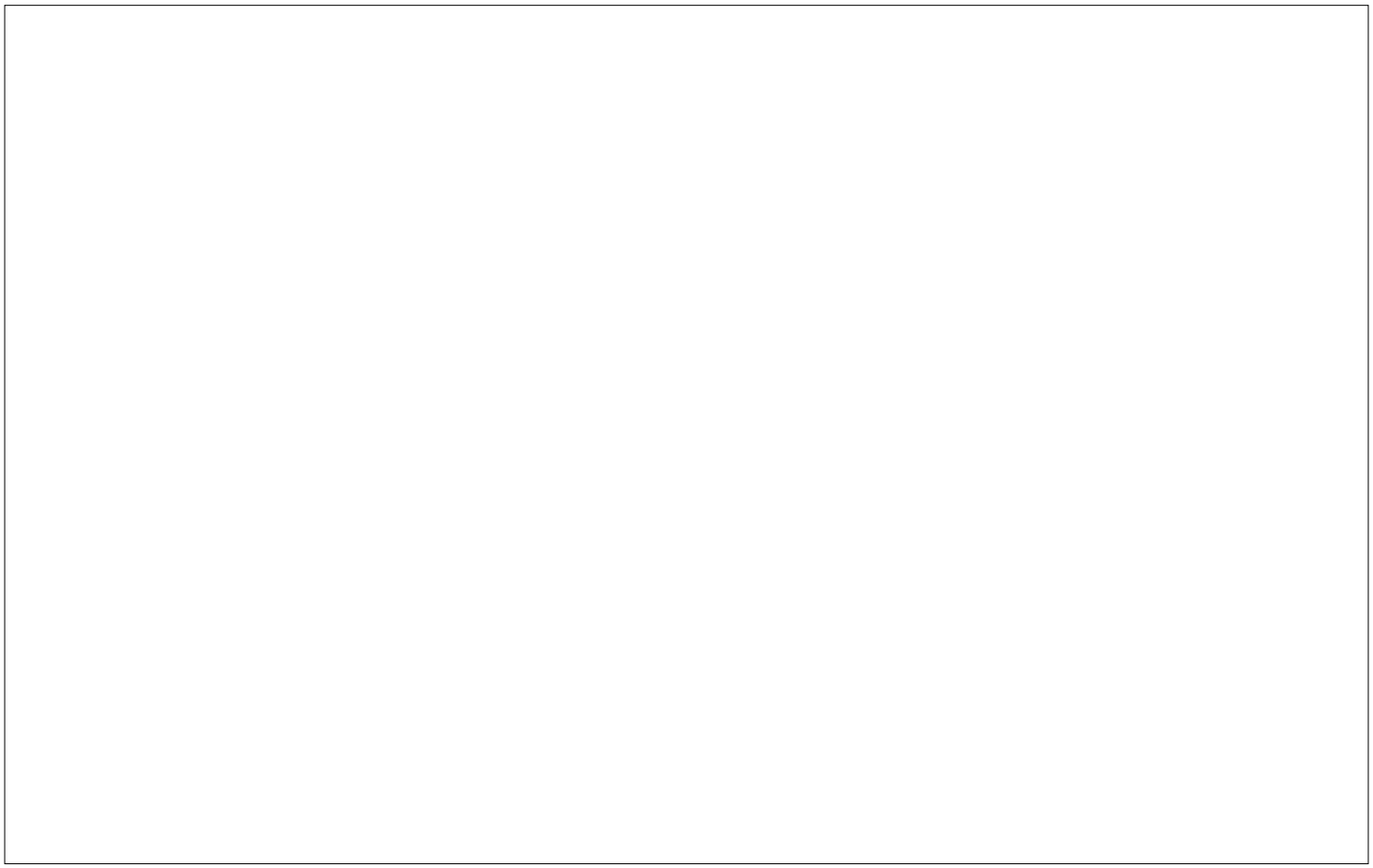
Color table

Color	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

So a resister that had a bands, in order: red, violet, orange, gold would be translated as

$27X10^3=27000\Omega$ with a 5% tolerance.

9. **In the space provided below, draw a diagram demonstrating the flow of electricity in the circuit you have created. Be sure to note the direction of the current's flow**.



Measuring voltage

1. Configure your multimeter to measure the voltage of your circuit.
    a. Connect the red lead to the VΩmA jack
    b. Connect the black lead to the COM jack
2. Attach the +/- leads from your multimeter to the respective +/- sides of the battery (26 and 27). You can just touch the wires connected to those positions.
3. Turn the dial on your multimeter to the closest voltage measurement you expect to see (hint…this is a NINE volt battery).
4. What voltage do you see on the window (it'll change, but should settle within a few seconds)?

5. Now with the help from a friend, take the leads and touch the wires leading out of 3 and 4 by the light. Have someone push the switch. What is the voltage?
6. Why is it different from the answer you got above? What is between the battery and the LED?
7. Change the resistance from 10kΩ to 1kΩ. Now what is the voltage with the switch on?

Measuring amps (current)

1. Amps are measured with the current running, since it's a measurement of current.
2. Configure your multimeter to measure the amps of your circuit.
    a. Plug in the red wire to the VΩmA jack
    b. Plug in the black wire to the COM jack
    c. Turn the dial to the Amp area (see directions…hint, Amp starts with A) closest to the amperage you expect to find. If you don't know, set it to the highest one and change until you get a reading that seems reasonable.
3. Have a friend hold down the switch.

4. Touch the leads to 3 and 4. Record the amperage.
5. Now let go of the switch and what readings do you get? Why?

6. Now take and touch the leads (without pressing the switch) to the wires at 55 and 56. What happens?

7. Why?

Because of this you must be very careful when testing amperage in a live circuit because you CAN complete that circuit. Your multimeter must have a high enough rating to handle the current.

Review Questions

Circle True or False.

1. Resistance is measured in ohms. True / False

2. A switch can act as a break in a circuit. True / False

3. AC is the acronym for ampere. True / False

4. A multimeter can measure only voltage. True / False

5. In a circuit, amps and volts are always the same amount when measured. True / False

6. Describe the difference in multimeter placement for measuring volts and amps.

Lab Notes

- **What does AC mean?**—Alternating current (AC) is current that cycles back and forth rather than traveling in only one direction. Normally between 110 and 125 AC volts are supplied from a standard wall outlet.
- **What are amps?**—Amps are units of measurement for electrical current. One volt across a resistance of one ohm will produce a flow of one amp.
- **What are volts?**—A volt is a measure of electrical pressure differential. A computer power supply usually provides four separate voltages: +12 V, -12 V, +5 V, and -5 V.
- **What is wattage?**—Wattage is a measure of the total amount of power that is needed to operate an electrical device.
- **What are ohms?**— An ohm is the standard unit of measurement for electrical resistance. Resistors are rated in ohms.

Lab 1-3 Measuring OHMs

Lab Checkoff

Requirement	Completed
Measure and record the resistance of a number of cables	
Demonstrate the proper use of a multimeter for measuring ohms	

Objective

The objective of this lab exercise is for you to identify the resistance of a variety of different conductors:

- Describe how to use a multimeter to measure resistance.
- Identify the levels of conductivity of a variety of cables

Materials Required

- Multimeter
- Cat 5 copper cable
- Wire
- Section of speaker cable
- Other cables

Lab Setup & Safety Tips

- Remember that when measuring ohms you must have the power turned off, so if you're going to measure a power supply, for example, turn off and disconnect the power.

ACTIVITY

Setting up the multimeter

1. Go to the website (link on our module page) that tells you how to set up the multimeter to measure ohms.
2. Touch the leads together to make sure you're getting a 0 ohm reading.

Measuring different wires

1. Get a variety of wires from me and from places around the room. Some examples might be
    a. Dead power supply
    b. IDE cable
    c. USB cable
    d. Speaker cable
    e. CAT 5 cable
2. Following the directions in the website, measure the different types of cables and record the characteristics and ohms below.
3. Measure the four required cables and find three others in the room.
4. If you can't get a reading, make a note of that and explain WHY you can't get a reading with our multimeters.
5. Answer the questions below.

Wire/Cable	Type of conductor (copper, aluminum, etc.)	Measurement	Notes
Cat5 Cable (be sure to measure wire for wire…if you touch one end to the blue/white, be sure you're testing blue/white on the other end)			
Speaker wire			

Red wire from box (electric playground)			
Purple wire from box			
Other_____			
Other_____			
Other_____			

Review Questions

1. Describe ohms.

2. Describe how to measure ohms using a multimeter.

3. Which wire had the highest resistance?

4. What kind of metal was it made of?

5. Which wire had the lowest resistance?

6. What kind of metal was it made of?

7. Using the information gathered in the table above, if you were creating a cable for high speed transmission, what kind of wire/metal would you want to use?

8. Why?

Lab 1-4 Power Troubleshooting

Pair up with another student and find a computer.

Student One: Come to me and get a Student 1 sheet. Follow the directions on the sheet and complete the lab.

Student Two: After student one has done his/her thing, come and get a sheet for student 2 from me and complete the lab.

Fill out the lab report.

Lab 1-5 Power Supply Protection

Lab Checkoff

Requirement	Completed
Install surge protector	
Installed UPS	
Recorded results of loss of power	
Answered questions	
Cleaned up area	

Objective

The objective of this lab exercise is for you to install and configure a surge protector and an uninterruptible power supply (UPS) device. After completing this lab exercise, you will be able to:

- Describe the functionality of a surge protector.
- Properly install and configure a surge protector.
- Describe the functionality of a UPS device.
- Properly install and configure a UPS device.
- Properly install and configure a power conditioner.

Materials Required

- One computer
- One surge protector
- One UPS device of any type
- One power conditioner

Lab Setup & Safety Tips

- Always unplug the power cord and properly ground yourself before touching any component inside a computer.

ACTIVITY

Installing a surge protector

3. Power off your lab workstation.
4. Power off your monitor and any other peripheral devices.
5. Plug the provided surge protector into the wall outlet.
6. Plug each of your peripheral devices into the surge protector (this includes the system unit and monitor).
7. Power on the surge protector.
8. Power on your lab workstation.
9. Power on your monitor and other peripheral devices (this includes the system unit and monitor).
10. Verify that your PC is functioning properly.

Installing a UPS device

6. Power off your system unit.
7. Power off any additional peripherals that you want to be protected by the UPS device.
8. Unplug the system unit and the peripheral devices.
9. Plug the UPS device into the wall outlet.
10. Plug the system unit into the UPS device.
11. Plug the additional peripheral devices into the UPS.
12. Power on the UPS device.
13. Power on the system unit and the additionally protected peripherals.

14. Verify that the system unit and each additionally protected device are functioning properly.

Observing the functionality of a UPS device

1. Power on your system unit and allow it to boot into Windows 9x.
2. Power on your additional peripheral devices.
3. Unplug the UPS device.
4. Record the results.

Review Questions

Circle True or False.

1. An in-line UPS can provide continuous power without downtime for switching from AC to battery. True / False
2. A power conditioner will provide battery power for only five minutes in the case of an outage.
1. True / False
2. If a computer is protected by a standby UPS, the computer will most likely reboot if there is a power outage. True / False
3. An intelligent UPS can be controlled by software. True / False
4. Describe how a surge protector provides protection from power spikes.

5. You are employed as a network administrator at Pictures, Inc. Your employer has asked you to assess the need for UPS devices for each of their 10 servers. After talking with the staff, you learn that seven of the servers are used for e-mail and bulletin board communications. The other three servers are used to maintain the company's accounting inventory databases. Pictures, Inc. has asked that you provide two proposals for them: the first should outline the ideal protection plan, and the other should outline the minimum protection requirements.

   Power Protection Plan A (ideal)

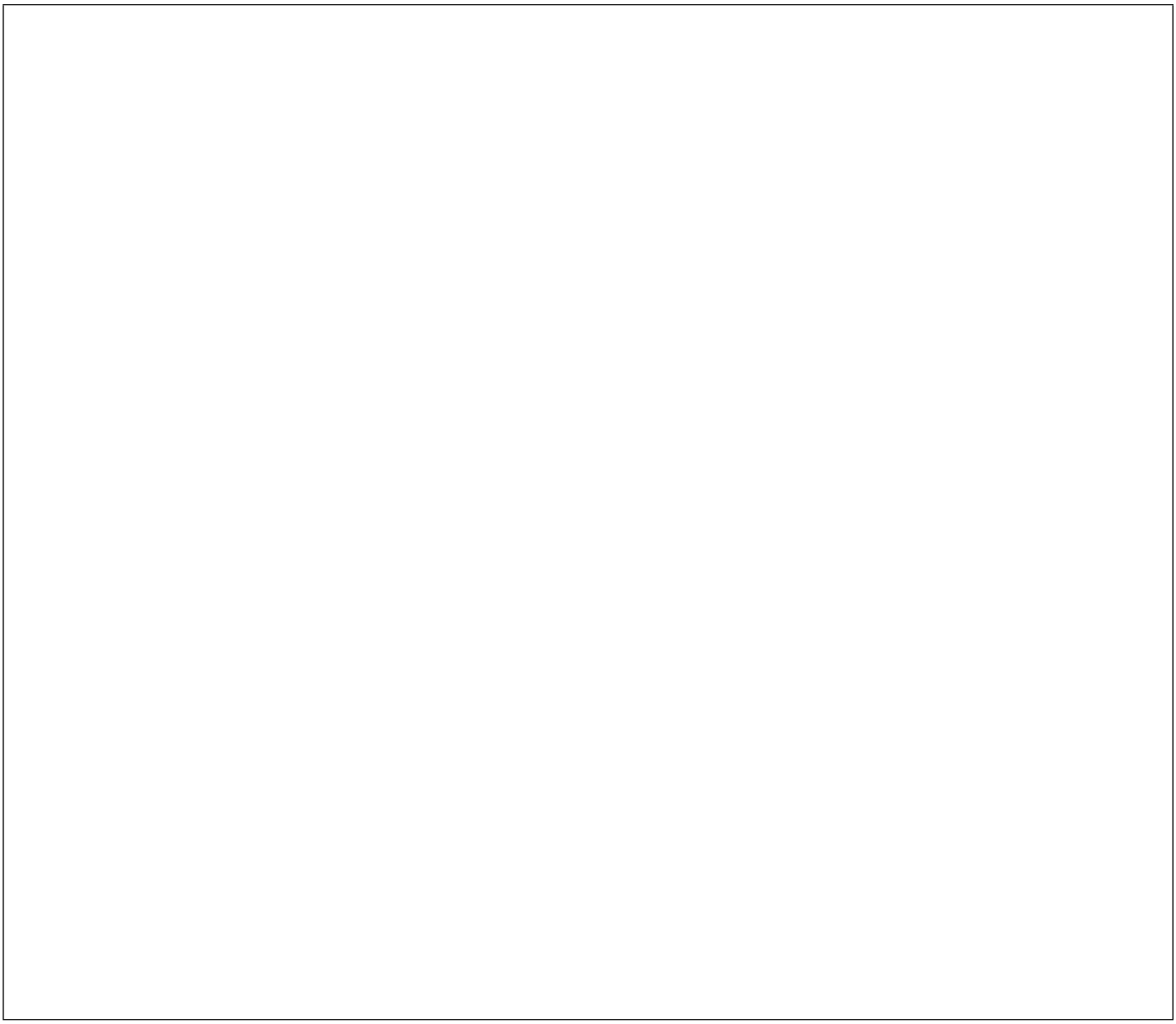
Power Protection Plan B (minimum requirements)

Lab Notes

- **What is an in-line UPS?**—An in-line UPS is a device that continuously provides power through a battery-powered circuit. Because it requires no switching, it ensures continuous power to the user.
- **What is a standby UPS?**—A standby UPS is a device that quickly switches from an AC power source to a battery-powered source during a brownout or power outage.
- **What is an intelligent UPS?**—An intelligent UPS is connected to a computer by way of a serial cable so that software on the computer can monitor and control the UPS.
- **What is a power conditioner?**—A power conditioner is a device that regulates, or conditions, the power, providing continuous voltage during brownouts.

Lab 1-6 How does a Power Supply Work

Go the webpage http://www.howstuffworks.com/power-supply1.htm and read the entire article on how Power Supplies work. In the box below, draw a computer power supply and label the components.



Answer the following questions:

1. Define switcher technology.

2. Where can you find information about your power supplies rating?

3. Describe how advanced power management saves electricity.

4. What are the form factors for power supplies?

5. What are common power supply problems?

6. How can you tell when a power supply has gone bad?

These questions will probably show up on the test!

Using a Multimeter

Test to Perform	Multimeter Setting	Probe Positions	Procedure
AC voltage (wall outlet)	AC	Red to hot, black to ground.	Read voltage from meter; should be near 115V in North America.
DC voltage (power supply outputs to motherboard, drives, batteries)	DC	Red to hot, black to ground (see next section for details).	Read voltage from meter; compare to default values.
Continuity (cables, fuses)	CONT	Red to lead at one end of cable; black to corresponding lead at other end.	No CONT signal indicates bad cable or bad fuse.
		For a straight-through cable, check the same pin at each end. For other types of cables, consult a cable pinout to select the correct leads.	Double-check leads and retest to be sure.
Resistance (Ohms)	Ohms	Connect one lead to each end of resistor.	Check reading; compare to rating for resistor.
			A fuse should have no resistance.
Amperage (Ammeter)	Ammeter	Red probe to positive lead of circuit (power disconnected!); black lead to negative lead running through component to be tested.	Check reading; compare to rating for component tested.

Lab 1-7 Testing Power Supplies

Objectives

- Identify some dangers involved in Power Supplies.
- Identify and diagnose common power supply problems.
- Test a power supply using a power supply tester.
- Test connectors on the power supply.

Materials Required

- Power supply
- Power supply tester
- Different connectors on power supply
- Multimeter

Directions

1. Get a power supply tester from me (check it out).
2. Read the accompanying instructions on how to test your power supply.
3. Get three power supplies from the cupboard. **Do not plug it in!**
4. Test each of the power supplies in the following manner
    a. Test the P1 connection
    b. Test each of the molex connectors
    c. Test the ATX connector, if present
    d. Test the SATA connectors
    e. Test the floppy connector, it present
5. Fill out the table below

Power Supply Brand	Wattage rating	P1 test	# Molex connectors	Molex tests (pass/fail, note any that fail)	# ATX connectors	ATX test	# floppy connectors	Floppy connectors Test

- If any of the power supplies completely fails, throw it away (ensuring that you've tested others first to make sure you're using the tester correctly).

- If any of the power supplies has bad connectors but the P1 works, get a piece of tape and mark the bad connectors.

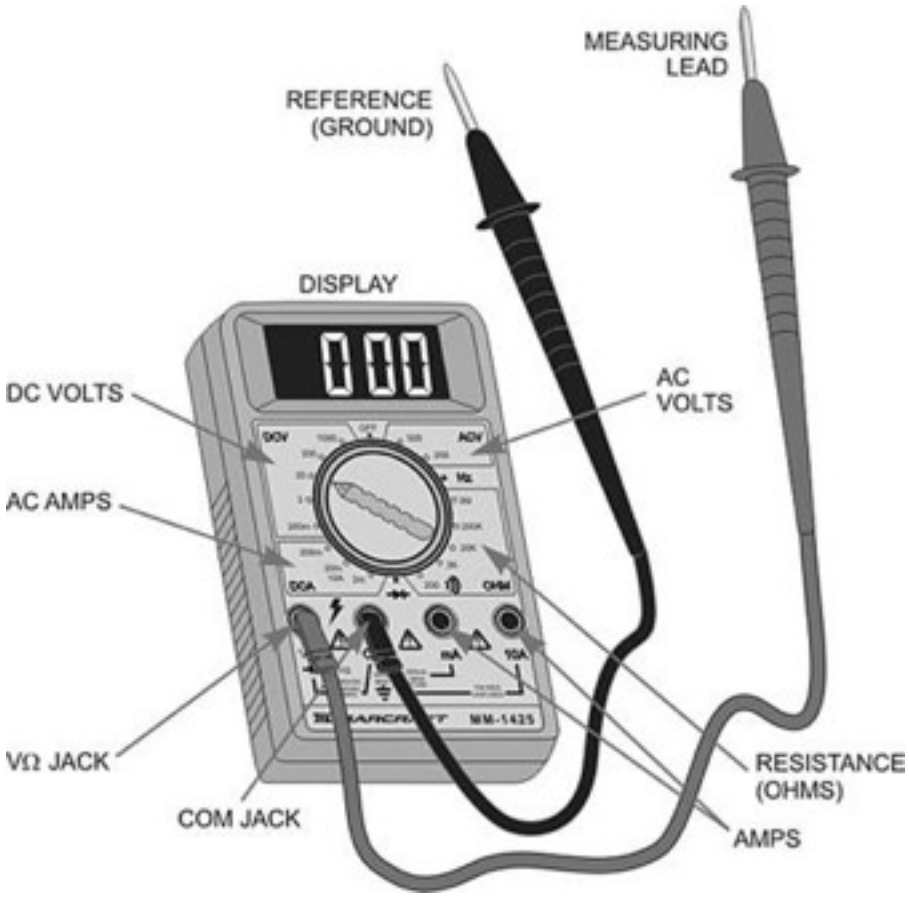
- If any power supplies has all of a specific kind of connector fail, throw it away

6. Now open up your lab computer, return your power supply tester, check out a multimeter.
7. The first step in using the multimeter to perform tests is to select the proper function. For the most part, you never need to use the current function of the multimeter when working with computer systems; however, the voltage and resistance functions can be very valuable tools.
8. In computer troubleshooting, most of the tests are DC voltage readings. These measurements usually involve checking the DC side of the power-supply unit. You can make these readings between ground and one of the expansion-slot pins, or at the system board power-supply connector.

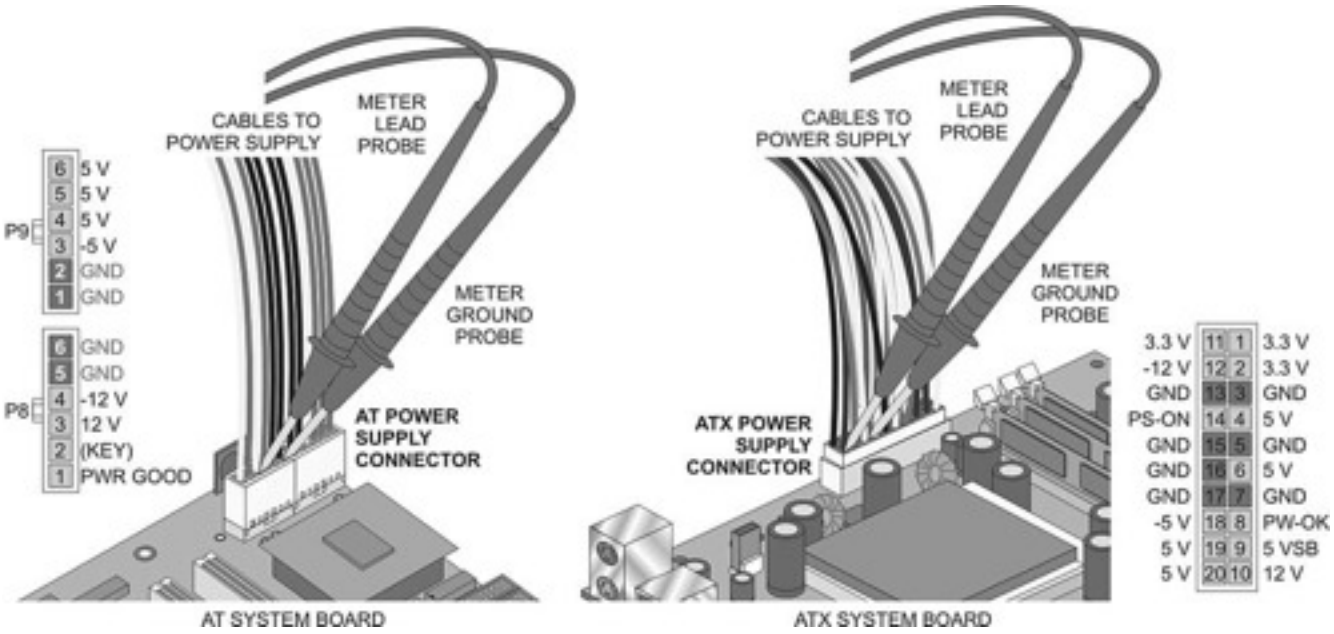
9. It is also common to check the voltage level across a system board capacitor to verify that the system is receiving power. The voltage across most of the capacitors on the system board is 5V (DC). The DC voltages that can normally be expected in a PC-compatible system are +12V, +5V, -5V, and -12V. The actual values for these readings may vary by 5% in either direction.

WARNING

Normal practice is to first set the meter to its highest voltage range to make certain that the voltage level being measured does not damage the meter.



10. The DC voltage function is used to take measurements in live DC circuits. It should be connected in parallel with the device being checked. In a PC system, this typically means connecting the reference lead (black lead) of the meter to a ground point and the measuring lead (red lead) to a test point to take a measurement, as illustrated in the figure below:



11. Note that on the side there is a label of what each of the cables in the P1 does.
12. Set your multimeter to DC volts 3.3. You're telling it what you're testing when you do this.
13. With the power off, connect the meter lead probe to the 3.3v connector on the power supply connector as shown in the second picture.
14. Connect the meter ground probe to the ground on P1.
15. Ensure that the multimeter is turned on and set to the correct settings. Set it down on the table with the probes in the power supply.
16. **Plug in the power supply and turn it on. Without touching anything, write down the reading you get below:**
17. Turn off the machine, unplug the power, remove the probes.
18. Do the same for the following positions and record the readings

Voltage	Reading	Voltage	Reading	Voltage	Reading
3.3		**-5**		**5**	
12		**-12**		**5**	

Remember to reset the multimeter each time to the proper reading.

Testing Resistance

1. The second most popular test is the resistance test, or *continuity test*.
2. Failure to turn off the power when making resistance checks can cause serious damage to the meter and can pose a potential risk to the technician. Resistance checks require that you

electrically isolate the component being tested from the system. For most circuit components, this means desoldering at least one end from the board.

3. The resistance check is very useful in isolating some types of problems in the system. One of the main uses of the resistance function is to test fuses. You must disconnect at least one end of the fuse from the system. You should set the meter on the 1 k ohm resistance setting. If the fuse is good, the meter should read near 0 ohms. If it is bad, the meter reads infinite. The resistance function also is useful in checking for cables and connectors. By removing the cable from the system and connecting a meter lead to each end, you can check the cable's continuity conductor by conductor to verify its integrity.

NOTE

4. An electrical short is a condition where electrical current is given a path of flow around a designated component. In some cases, the short may be a complete bypass to a ground point so that no components receive current to operate with. On the other hand, an open is a condition that is created when no path for electrical current is present, such as when a connector comes loose or a component burns out.
5. Get one of our older motherboards.
6. Carefully locate a fuse and remove it.
7. Set the meter to 1k ohm and test it.
8. What is the reading?

Testing Speakers

9. You also use the resistance function to test the system's speaker.
10. To check the speaker, simply disconnect it from the system and connect a meter lead to each end. If the speaker is good, the meter should read near 8 ohms (although a smaller speaker may be 4 ohms). If the speaker is defective, the resistance reading should be 0 for shorts or infinite for opens.
11. **What reading did you get?**

Only a couple of situations involve using the AC voltage function for checking microcomputer systems. The primary use of this function is to check the commercial power being applied to the power-supply unit. As with any measurement, it is important to select the correct measurement range; however, the lethal voltage levels associated with the power supply call for additional caution when making such measurements. The second application for the AC voltage function is to measure ripple voltage from the DC output side of the power-supply unit. This particular operation is very rarely performed in field-service situations. We’re not going to do it, lest we die.

Lab 1-8 Testing Capacitors

1. Get yourself an Electronic Playground.
2. Locate the capacitors on the kit and draw each of them below:

Rating	Drawing of capacitor

3. Get three long wires and one short wire from me.
4. Connect one wire between 3 and 42
5. Connect one wire between 4 and 26, and another between 26 and 37 (note, put wires on either side of 26, try not to let them touch)
6. Take another long wire and attach it ONLY to 36, leave the other end unattached.
7. Now let's "charge" that capacitor.
8. Take the loose wire and touch it to 27, the other battery spring.
9. BAM your capacitor just charged. Since there is no resistance, it's immediate.
10. Now touch the loose wire to the other side of the 3.3kΩ resistor and watch the LED.
11. What just happened?

12. Do it again…touch 27 then 43.
13. So what is the purpose of a capacitor on a motherboard?

14. Is it a very effective battery?
15. So why even have it?

16. Try the other resistors and tell me what happens:

Resistor rating	What happens	Why do I think this happens?

17. Test the different capacitors, and tell me what happens.

Capacitor rating	What happens	Rate from 1-3 for effectiveness at holding a charge

18. What would the lower charge capacitors be used for?

Lab 1-9 PC Power Supply Facts

Remove the cover from your home or lab PC and answer the following questions:

1. How many watts are supplied by your power supply? (It is usually printed on the label on the top of the power supply.)

2. How many cables are supplied by your power supply?

3. Where does each cable lead?

4. Is there a switch on the back of the power supply that can be set for 220 volts (Europe) or 110 volts (U.S.)?

Lab 1-10 Total Wattage Used by Your Computer System

Fill in the following chart and then calculate the total wattage requirements of your computer system compared to the rating of your power supply. Include in the chart all devices that draw power from the power supply. Look for a wattage rating printed somewhere on the device.

Component	Wattage
Hard Drive	
CD ROM	
Floppy Drive	
AGP Video Card	
CPU	
RAM	

Motherboard	
PCI Cards (multiply it by how many cards you have in your system)	
Total Wattage	

Total wattage requirements: _____

Wattage rating of the power supply: _____

This power supply is running at percent of full capacity. _____

Why should you check this before you purchase your power supply?

Lab 1-11 Diodes

1. Get yourself an Electronic Playground.
2. Locate the diode on the kit and draw each of them below:

Draw the diode	Draw the symbol that means diode

3. Get 2 long wires and 3 short wires from me.
4. Connect a short wire between LED 3 and the 11 at the end of your diode.
5. Connect a longer one between 11 and 43.
6. Connect the other end of your resistor to one side of the switch (55)
7. Connect the other side of the switch to the other side of the LED (4 to 56)

The job of a diode is to only allow electricity to flow in ONE direction. Note the symbol. Which way do you believe this diode allows a flow? **(Circle one)**

a. From 10 to 11
b. From 11 to 10

8. Push the switch.
9. What just happened?

10. Now reverse the wires to the diode (just swap 10 and 11).
11. Push the switch and record what happened.

12. Why did that happen?

13. So what is an LED?

Aha! The word DIODE is in there isn't it? That's because diodes made of Gallium Arsenide (say that three times fast) required at least 1.5V to turn them on. When the voltage is that high, it generates light. Let's play with our LEDs.

14. Wire as follows
    a. 37 to 42
    b. 43 to 1 to 4
    c. 2 to 3 to 26
    d. 36 to an unconnected wire
15. We're not using diodes because the LEDs ARE diodes.

16. Now touch the loose wire to the positive battery spring (27). What happens:

    a. To LED1

    b. To LED2

17. Why does one light up, but not the other?

18. Now touch the loose wire to the negative battery spring (26). What happens:

    a. To LED1

    b. To LED2

19. Why does this happen? What does this tell you about the direction of the LED diodes?

Unit Project—Power Supplies

A customer brings in a computer with the following problem:

I built a computer myself. I've got Windows 7 Home Ultimage, a Gigabyte ASRock A75m motherboard, an AMD A4-3300 Llano processor, a Visiontek 900369 Radeon HD 6670 video card, four sata drives (3.0) 1 TB each (3 are setup in a RAID), PCI wireless adapter, 8 Gig DDR3 2400+ RAM, a BluRay player, and a DVD-RW drive.

The problem is that it keeps resetting in a sporadic manner. It can go all day and then suddenly reboot, or it can reset itself immediately after having been switched on.

I emailed the mobo manufacturer and they think it's the power supply, but I don't think so. It's 450 watts, which is more than enough. The power supply came with the case, so I'm sure it's fine.

Task One: Create a list of words that must be defined in order to answer the customer's question.

Task Two: Develop a list of questions that must be answered before you can begin fulfilling the customer needs. Email your questions to ppumpkin@teechur.com

Task Three: Develop a customer overview. Who is this guy? What does he need? How can you help?

Task Four: Determine a list of his current needs and potential future needs.

Task Five: Research the power requirements for his system. Create a table that shows the amount of power each component is pulling. If he doesn't have a component listed, assume a generic brand. (In other words, just because he doesn't say he has a floppy drive, doesn't mean he doesn't have one. Assume that he does as well as a modem or network card, and other common components.

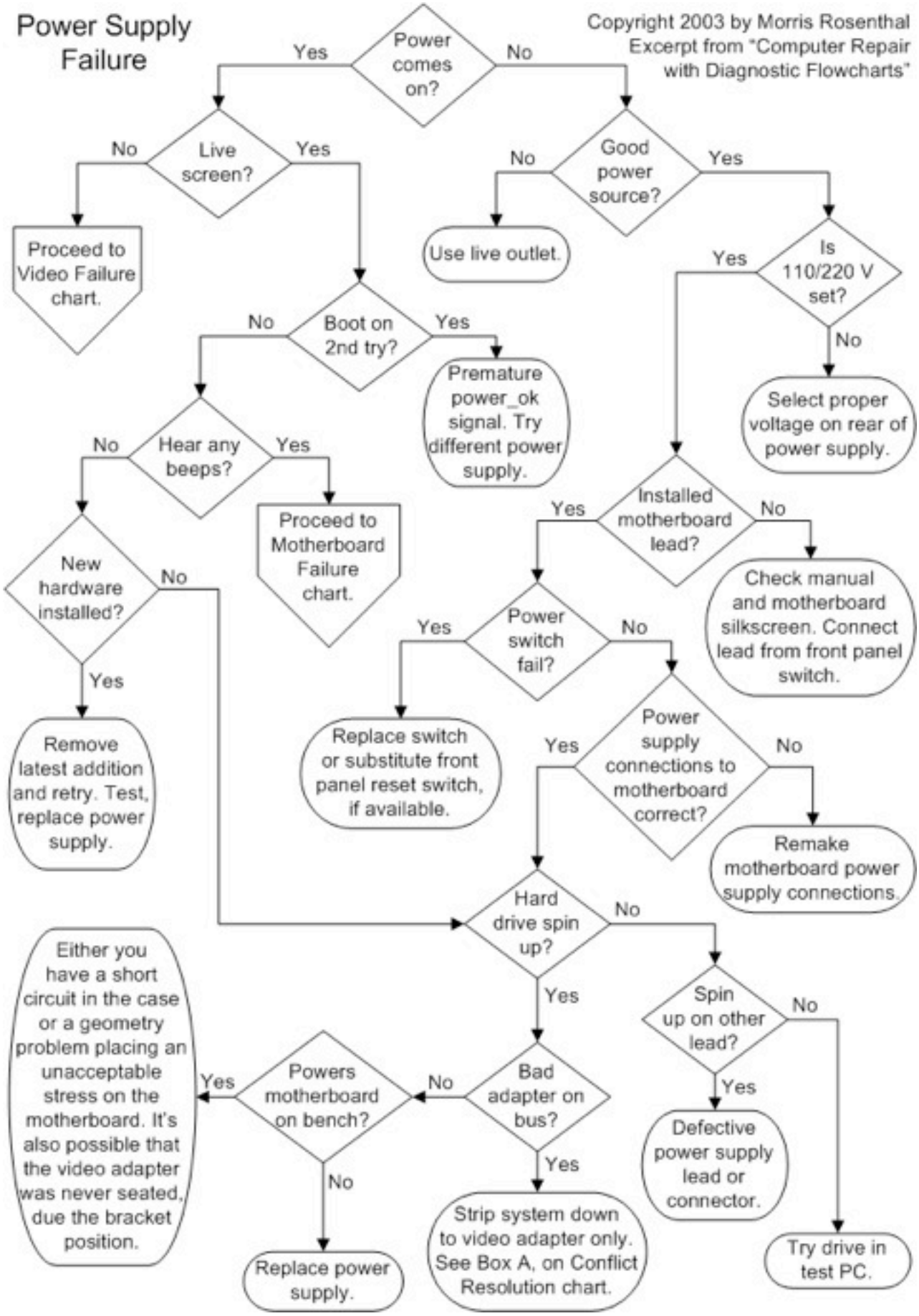
Task Six: Develop a theory about what might be causing his problem. Then develop a list of steps to take to troubleshoot and test the theory. These steps must include more than just "get a new xx". How should he test it? What should he use for testing? What readings? Etc.

Task Seven: Research the requirements for the task he's asking you to complete.

Task Eight: Create a simple step by step package, complete with diagrams and screen shots, that will explain to him:

1. What it is he wants to do. Use proper terminology.
2. How to set it up.
3. The different ways he can set it up. Be CLEAR.
4. Any additional hardware or software requirements.
5. Troubleshooting tips for when it doesn't work.
6. Your suggestion for the best way to set it up.

Task Seven: Create a complete proposal that outlines what you can do for the customer. Include drawings and images, price quotes, and other items as applicable.


Power Supply Failure
Copyright 2003 by Morris Rosenthal
Excerpt from "Computer Repair with Diagnostic Flowcharts"
Power comes on?
Yes
No
Live screen?
No
Yes
Proceed to Video Failure chart.
Boot on 2nd try?
No
Yes
Premature power_ok signal. Try different power supply.
Hear any beeps?
No
Yes
Proceed to Motherboard Failure chart.
New hardware installed?
No
Yes
Remove latest addition and retry. Test, replace power supply.
Good power source?
No
Yes
Use live outlet.
Is 110/220 V set?
Yes
No
Select proper voltage on rear of power supply.
Installed motherboard lead?
Yes
No
Check manual and motherboard silkscreen. Connect lead from front panel switch.
Power switch fail?
Yes
No
Replace switch or substitute front panel reset switch, if available.
Power supply connections to motherboard correct?
Yes
No
Remake motherboard power supply connections.
Hard drive spin up?
No
Yes
Spin up on other lead?
No
Yes
Defective power supply lead or connector.
Try drive in test PC.
Bad adapter on bus?
No
Yes
Strip system down to video adapter only. See Box A, on Conflict Resolution chart.
Powers motherboard on bench?
Yes
No
Either you have a short circuit in the case or a geometry problem placing an unacceptable stress on the motherboard. It's also possible that the video adapter was never seated, due the bracket position.
Replace power supply.